S.J.B

A. M. D. G.

American Association of Jesuit Scientists

Eastern States Division

PROCEEDINGS

of the

Fifteenth Annual Meeting

August 31, September 1, 2, 1936

Holy Cross College, Worcester, Mass.

Published at

LOYOLA COLLEGE

BALTIMORE, MARYLAND

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FIRST GENERAL SESSION

The Fifteenth Annual Meeting of the American Association of Jesuit Scientists, Eastern States Division, was held at Holy Cross College, Worcester, Massachusetts, on August 31, October 1 and 2, 1936. The first general session was held on Monday, August 31, at 7:45 P. M. in Kimball Hall Auditorium, Rev. Henry M. Brock, S.J., President of the Association, presiding.

The meeting opened with a prayer, followed by the welcoming address by Rev. Joseph J. Sullivan, S.J., Dean of the Chemistry Department, Holy Cross, who greeted the members in the absence of the Rev. Francis J. Dolan, S.J., President of Holy Cross.

After Fr. Sullivan's address of welcome, a motion was made to omit the reading of the minutes, since they had already been published in the September (1935) issue of the Bulletin. The motion was seconded and carried.

Fr. Brock then named the following committees:

Committee on Resolutions:	Fr. John A. Tobin, S.J.
	Fr. Charles A. Berger, S.J.
	Fr. Thomas J. Smith, S.J.
Committee on Nominations:	Fr Francis W. Power, S.J.
	Fr. Emeran J. Kolkmeyer, S.J.
	Fr. Joseph F. Busam, S.J.

Fr. Henry M. Brock then delivered the Presidential Address.

PRESIDENTIAL ADDRESS

Some Limitations Of Physical Science

REV. HENRY M. BROCK, S.J.

The era of modern science, with its insistence on observation and experiment, is generally supposed to begin something over three centuries ago in the days of Newton and Galileo. However its influence on human thought and ways of living only became conspicuous during the latter half of the nineteenth and during the twentieth century. Astronomy had already revealed a new universe and later Geology made known the history of our earth. Biology, Chemistry and Physics, with their conquest of disease, production of new substances, the utilization of power and the development of all sorts of mechanical and electrical devices, have provided new ways of making a livelihood and have revolutionized food production and conservation, transportation, recreation and amusement and almost every detail of human life within the memory of men still living. There is now a popular interest in science. Scepticism regarding scientific claims, once not uncommon, has been followed by ready acceptance of any discovery and theory and even by a certain credulity. Such wonders have been accomplished that anything is considered possible and there is often little appreciation of the technical difficulties involved in the solution of specific problems, as for example television.

It is natural therefore for many people to expect from science more than it can give. Two instances may be mentioned which are familiar to us all. While the Copernican theory changed men's ideas about the position of our earth in the universe, it was the advance of science in the nineteenth century, notably the growth of geology and the enunciation of the Darwinian theory, which weakened the faith of many Christians, chiefly Protestants, in Europe and America. Certain popular writers proclaimed that the Bible had received its death blow and fostered the hope that the new learning would replace the old religion. Evolution was to take the place of God and science would solve all men's problems. Instructed Catholics, with the centuries of Catholic tradition behind them and secure in the teaching authority of the Church, were more cautious and were not so easily led astray. While they welcomed true science and gladly admitted its apologetic value in its evidence for intelligence and design in the universe, they were not deceived regarding its theological limitations. Nevertheless the so-called conflict between science and theology or the Church was emphasized especially by writers like Draper and White.

Time has tended to convince the unprejudiced not only that the Church is not opposed to science and hence there can be no true conflict, but also that science cannot take the place of religion. Moreover Catholic interest in science is shown by the achievement in this

field of many Catholics both clerical and lay and by the example and words of our present Holy Father. We may not yet occupy the position which should be ours considering our numbers, but at any rate progress in recent years had been rapid and gratifying.

Among non-Catholics we see prominent men of science, especially physicists, writing on religion and immortality and on the evidences of design in creation. We have books with titles like "I Believe in God and Evolution," "Through Science to God", etc. The forms of religion they advocate may differ much from Catholicism, but it is noteworthy that they seem convinced that science leads to God rather than away from Him. We can give them credit for their good intentions.

A second instance is the fact that the advance of science also caused many to believe that it not only had no need of philosophy but that it would supersede it. It became the fashion to deride the philosophers, especially those of the middle ages, who were supposed to waste their time in inane hair splitting and speculation while the wonders of nature were lying at their feet waiting to be discovered. Physics was real, metaphysics was unreal. Yet the startling discoveries and theories of our day, especially in the field of Physics, have themselves brought the man of science face to face with first principles and the fundamental notions of metaphysics. He has been forced to reconsider the logic of science and to seek new light on the concepts of time and space, action, simultaneity, causality and determinism. He finds that he can not stand alone and that a sound philosophy has something to offer him beyond his own science. This significant fact is brought out in an article by Treadwell Cleveland in the Technology Review for April 1936 in which he discusses some of the changes which have taken place in the seventy-five years since the Mass. Institute of Technology received its charter. He says, "When the sciences first began to know their strength, especially in the closing years of the last century and the earlier years of this, they prided themselves on their precision, their quantitative results. They tended, indeed, to insist that quantitative results alone were worth while. As a result, there crept upon philosophy a new mechanistic and material palsy, which deprived it of steadiness and self-reliance. Science has now waived these claims to be the universal tutor and the final arbiter of values: a new idealism is taking courage and finding strength. Philosophy is reasserting its rights as critic and reconciler of that many-sided knowledge which flows to the mind from every source." It may not be clear just what philosophy is referred to here. Catholic philosophy has been cognizant of its functions and has always faced the problems in question. The respective fields of philosophy and science are evident enough to us, but it is gratifying to see that others are realizing the need of the latter for the former. In this connection mention may be made of an article by R. M. Hutchins, President of the University of

Chicago, in the current number of the Yale Review in which he insists on the importance of metaphysics not only for science but also "to establish rational order in the modern world as well as in the universities."

There are other limitations which pertain more to experimental science and I prefer to dwell rather on these than on those that are theological and philosophical. Certainly no man in our times would be rash enough to set any limit to the possibilities of new discoveries and theories with their subsequent applications. Past history and present progress indicate that the field is almost inexhaustible, and new discoveries only multiply new problems. But progress has not always been uniform. It may slow up for a time and then some new theory or method or instrument may open up new fields of research. We see this in the development of the theory of gravitation, of the wave and quantum theories of radiation and also in the applications of the telescope and spectroscope in astronomy, the microscope in biology and the thermionic vacuum tubes in physics.

There was such a lull towards the end of the nineteenth century. Indeed some thought that the great scientific harvest had already been gathered in and that there was only work left for the gleaners. The eminent American physicist A. A. Michelson in a course of lectures given at the Lowell Institute in Boston in 1899 and published afterwards with the title, "Light Waves and Their Uses", expressed the view common at the time. His words must have been an occasion of amusement if not of chagrin to him in his later years. He said, "The more important fundamental laws and facts of physical science have all been discovered and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote." He points out how greater refinement in measurement has revealed apparent exceptions to laws and these have led to new discoveries. After citing examples he says, "these will suffice to justify the statement that our future discoveries must be looked for in the sixth place of decimals." When these words were being uttered Physics was just beginning one of the most fruitful and revolutionary epochs in its history. Startling phenomena and laws were to be discovered which had little connection with the sixth decimal place. Indeed it would be difficult to fit some of them into the scheme of nineteenth century physics. But no one at that time could foresee this.

Much progress does indeed depend on more and more refinement in measurement. But the question may be asked; to multiply discoveries must we keep on increasing refinement? If future discoveries are to be looked for in the sixth decimal place in the nineteenth century, why not in the seventh or eighth in the twentieth? Is there any limit in sight? It is true that some measurements are by their

very nature approximate. For example how could one measure the diameter of a tree or even of an orange to a fraction of a millimeter? How could one be sure of the length of a live earth worm to less than a millimeter? Others again are limited to certain average values as, for example, the temperature at Worcester at any hour of the day. But even so-called precise measurements have their limitations. Measurement implies comparison with standards whose magnitudes are only known to a certain degree of accuracy. Our instruments and methods have their characteristic errors which may often be made negligible for all practical purposes, but residuals always remain. And even if our instruments were perfect, there will always be accidental errors due chiefly to our senses. Astronomers, chemists and physicists are therefore careful to give an estimate of the accuracy of their results in the form of a probable error or percentage deviation. The uncertainty can undoubtedly be diminished as time goes on but there is no indication that it can be completely eliminated.

Increase in accuracy and precision is conditioned largely by increase in the sensitivity of our measuring devices. Progress in this respect has been so great that definite limits are appearing in certain classes of measurement beyond which we cannot at present hope to go. For example, many of our instruments, e.g. galvanometers, electrometers, radiometers indicate the quantity to be measured by the deflection of a mass, such as a coil suspended by means of a fine wire or fibre. Sensitivity is increased by reducing the mass of the suspended body and by making the suspension finer. When extreme sensitivity is sought, we find ultimately that the zero reading becomes unsteady. There are continual minute fluctuations which persist even when all extraneous disturbances are removed. It thus becomes impossible to read accurately very small deflections on account of the difficulty of distinguishing them from the random fluctuations. The cause of this phenomenon is chiefly the Brownian movement i.e. the irregular impact of air molecules on the suspended mass. One would naturally think that steadiness would be obtained by placing the suspension in a high vacuum. The fluctuations may be diminished but they will still persist, even when the pressure is reduced to one ten billionth of an atmosphere. In this case they are due to thermodynamic fluctuations in the suspension itself causing minute variations in torsion.

Many of our measurements are electrical and here sensitivity can be increased by using amplifiers depending upon thermionic vacuum tubes. Instrumental deflections can generally be made large enough to render the Brownian movement negligible. But here again we reach a limit. As we know, an electrical current is a flow of electrons through a conductor. Whether a current flows or not, there are always minute irregular motions of the free electrons—mostly vibratory—which set up instantaneous irregular potential differences capable of producing a current if there is a closed circuit. If now the

current to be measured becomes so small as to be of the same order of magnitude as this random current, it cannot be measured accurately because both are amplified to about the same degree and one cannot be disentangled from the other. Cooling would improve matters but obviously the whole circuit cannot be at absolute zero. This phenomenon is of practical importance in telephony. Speech is transmitted by means of complex periodic currents. These currents undergo progressive attenuation along the line quite independently of leakage and vacuum tube relays are used for long distances. There is a very definite limit to the attentuation which may be permitted. If the voice currents drop to the magnitude of the random currents they become mixed up with them and cannot be separated. Amplification is of no avail. The only result is noise.

Our present methods of amplification are subject to other similar limitations on account of minute fluctuations in plate currents due 1) to irregular electron emission in the vacuum tubes and 2) where magnetism is involved, to minute discontinuities in magnetic changes. Here again when the current observed drops to the value of these fluctuations it is lost and cannot be measured.

In optics perception depends on definition or sharpness of detail. The limits of the human eye have been enormously extended by the telescope and microscope. The former has steadily increased in size and hence in light gathering and resolving power although the reflectors have long since outstripped the refractors. The Yerkes telescope, with its forty-inch objective constructed over forty years ago, is still the world's largest refractor. There will doubtless be instruments constructed in the future larger than the two hundred inch reflector now under construction. However it seems true that as the size increases the rarer are the occasions when the telescope can be used with maximum power. This fact together with the enormous expense and technical difficulties involved may set a practical limit in the future. As Moulton points out, astronomers would prefer much more sensitive photographic plates than much larger telescopes.

In microscopes the resolving power depends largely on the kind of light employed increasing with decrease of wave length. Direct vision with the microscope reaches its limit with the violet. Microphotography can use the ultra-violet but practical limits are reached when the radiation used is absorbed by lenses, air and even the photographic gelatin. The penetrating radiation of the high frequency end of the spectrum, such as X rays, would increase resolving power enormously, but there is the difficulty about focusing.

However, as we diminish the size of the object to be observed, we are confronted by a new limit indicated by the quantum theory and enunciated a few years ago by Heisenberg in his Uncertainty Principle. If we wish to study a body of any kind in detail, we must obviously know at least where it is and, if it is moving, we should also know in what direction and how fast it is going. According to

Heisenberg, there is a curious limitation to the determination of these two quantities, position and velocity. The more accurately we can know the one the less accurately we can know the other. The product of the values of the two uncertainties is of the magnitude of Planck's constant divided by the mass of the body. This limitation is imposed by nature and hence is quite independent of experimental technique or error. It appears to be quite universal. Physicists have tried to find some exception but apparently without success.

The Heisenberg Principle is at present of little practical importance. Its effect when dealing with bodies of ordinary size is utterly infinitesimal. The uncertainty due to actual experimental errors in measurement is enormously greater. It is only when we consider particles of atomic or sub-atomic dimensions that we have to take it into account. However it has considerable theoretical importance since it seems to set a very definite limit to certain predictions and it seems to lend weight to the statistical aspect of certain natural phenomena and laws. According to classical theory it has always been supposed that, given the positions and motions of all the particles in the universe at any particular instant, it might be ultimately possible, theoretically if not practically, to determine their positions and motions at any time in the future. But, if according to Heisenberg we cannot know with sufficient certainty the present positions and motions of atoms and electrons, how can we predict with any accuracy their future states? Some hold that this spells the end of determinism while others seem to think that it invalidates the principle of causality. The latter statement would be rather disconcerting if it were true, especially for the philosophers. But there is no occasion for surprise or alarm. The subject was clearly discussed at our last meeting by Fr. Joseph P. Kelly. (Bull. XIII, No. 1 p. 29). As he points out, there is no question of the philosophic concept of causality with which we are familiar. This pertains, not "to the prevision of an effect, but to the explanation of its coming into existence." Whereas the Heisenberg Principle has reference to the impossibility of accurate prediction under certain conditions. We have here another example of the importance in any discussion of agreeing on our definitions and on the enunciation of the principle we wish to discuss. We realize the difference between uncertainty or irrationality in nature and uncertainty in our knowledge of what is or is going to be. H. Dingle in Nature for May 4th, 1935, brings out the point. He says, "The experience of causality in limited systems is a fundamental fact. It is impossible that scientific developments can overthrow it without destroying their legitimacy, for it is their basis. The sum and substance of the matter is that we have found that the data by which we thought we could forecast the future are unattainable. There is an important difference between this and the statement which is frequently made, that the quantum theory requires that an experiment can be repeated several times under precisely

similar conditions with various results. If that were true, it would indicate an irrationality in nature which would be the negation of science. What the theory does show is that, if we define similarity of conditions as similarity of positions and momenta of the physical systems concerned, we can never be sure that we are repeating the experiment under precisely similar conditions.

One reason for the Heisenberg Principle is the fact that a particle cannot be observed without disturbing it in some way and the smaller the body the more significant the disturbance becomes. It has usually been considered only in Physics, but a few months ago the Danish physicist Bohr asserted that it also has a place in Biology, especially in the study of the cell. It is well to bear in mind in all discussions that the Principle is a deduction from the quantum theory.

The question may also be asked if there are any limits in largeness appearing. The velocity of light as a limiting value in connection with the theory of relativity may be mentioned, but there is no time to discuss this topic. The limits indicated in this paper seem to set up certain barriers. We see no way of going beyond them, especially as they appear to be imposed by nature. We cannot see far into the future but we may be sure that in spite of them science will continue to advance, adding stone after stone to the majestic temple of truth which the human mind has been building during the centuries.

After the Presidential Address, Fr. George A. O'Donnell related the proceedings of and the resolutions adopted by the Jesuits in Convention at the A. A. A. S. meeting at St. Louis, Missouri, in December, 1935. He proposed that at the final general session on Wednesday a discussion should be held on the following questions: First, how the founding of a national Jesuit scientific journal should be brought about, and what type of articles should be published in such a journal, if founded; Second, whether it would be feasible, and how it would be possible, to establish Jesuit science institutes in any or all of our colleges.

Fr. Emeran J. Kolkmeyer next proposed a further topic for discussion at the final general meeting, concerning the advisability of inviting the Canadian Jesuit Scientists to membership in the Eastern States Division of the American Association of Jesuit Scientists.

Fr. Richard B. Schmitt requested the Chairman and Secretary of each Section to collect and submit to him on Wednesday abstracts of all papers presented in their respective sectional meetings.

Fr. John P. Smith informed the members of the Association that the meeting place of the 1936 convention of the A. A. A. S. had been changed.

The meeting adjourned at 8:30 P. M.

FINAL GENERAL SESSION

The final general session convened on Wednesday, September 2, at 10:45 A. M., in Kimball Hall Auditorium.

The Secretaries of the sections reported the officers for the coming year as follows:

Biology:
Chairman Fr. Arthur A. Coniff, S.J.
Secretary Mr. Joseph W. Murray, S.J.

Chemistry:
Chairman Fr. Thomas B. Butler, S.J.
Secretary Mr. Joseph A. Martus, S.J.

Mathematics:
Chairman Fr. Thomas D. Barry, S.J.
Secretary Mr. Anthony J. Eiardi, S.J.

Physics:
Chairman Fr. John A. Tobin, S.J.
Secretary Mr. Laurence C. Langguth, S.J.

Fr. John A. Tobin, Chairman, read the report of the Committee on Resolutions, presenting the following resolutions for approval:

1. Be it resolved that the American Association of Jesuit Scientists (Eastern States Division) express its appreciation and gratitude to Reverend Father Rector, Father Minister and the Community of Holy Cross College for their cordial reception and for the gracious hospitality shown to it during the meeting.

2. Be it resolved that we express our appreciation and gratitude to the various officers of the Association for the labor entailed in making this meeting a success.

3. Be it resolved that we express our appreciation and gratitude to the Editor-in-Chief of the Bulletin for his patient labor in making that publication so helpful to the Association.

4. Be it resolved that a copy of these resolutions be presented to Reverend Father Rector of Holy Cross College by the Secretary.

Committee on Resolutions:

Fr. John A. Tobin, S.J..
Fr. Charles A. Berger, S.J.
Fr. Thomas J. Smith, S.J.

These resolutions were seconded and unanimously approved by the Association.

Fr. Richard B. Schmitt recommended a change in the financial management of the Bulletin, suggesting that either the Secretary-Treasurer take over the duties of collecting the assessments, or a new office be created for that purpose by an amendment to the Constitution. Discussion followed, until Mr. James K. Connolly moved that the Executive Committee appoint an Acting Treasurer for the coming year, and that the proposed Amendment be voted on at next year's meeting.

Fr. Richard B. Schmitt suggested the formation of a new Section in the Association, that of Science and Philosophy; and also pleaded for a greater number of contributions to the Bulletin. He also reminded the members that back numbers of the Bulletin were available for those who wished to complete sets. The earlier mimeographed numbers may be obtained from Woodstock and Weston and the later printed ones from Weston and Loyola, Baltimore.

Fr. George A. O'Donnell and Fr. Emeran J. Kolkmeyer opened the discussion of the topics presented at the first general meeting, that of the national Jesuit scientific journal and of the science institutes. General discussion followed, but no resolution was passed. However, the sentiment of the members seemed to be against the formation of a national research journal of such a nature as to compete with the existing non-sectarian journals, and likewise seemed to be against the formation of a science institute, as a project which, though zealous and laudable, is impracticable at the present time.

The nominating committee announced that Fr. Berger and Fr. Assmuth were proposed for the Presidency, and Mr. Thiry and Mr. Langguth for the Secretariat. The members elected Fr. Berger, President and Mr. Langguth, Secretary.

Fr. Brock addressed the gathering briefly, thanking them for the honor of presiding at the meeting, and expressing his gratification at the development of the Association during the years since its hopeful inception; whereafter Fr. Berger took the Chair at about 12.00 noon.

Fr. Kolkmeyer suggested the invitation of the Canadian Jesuit scientists to associate membership in the American Association of Jesuit Scientists, Eastern States Division. The Reverend President assumed the responsibility of extending this invitation to those members of the Canadian Provinces who might be interested.

The motion for adjournment was made and carried.

PRESENT AT THE FIFTEENTH ANNUAL MEETING

Fr. Daniel Linehan
Fr. Peter J. McKone
Fr. Thomas J. Smith
Fr. John A. Tobin
Fr. Joseph T. O'Callahan
Fr. Henry M. Brock
Fr. Joseph M. Kelly
Fr. Joseph P. Delaney
Fr. E. J. Kolkmeyer
Fr. Herbert P. McNally
Fr. Francis B. Dutram
Mr. Theodore A. Zegers
Mr. Charles McCauley
Mr. William H. Dowling
Mr. James Ring
Mr. James J. Fitzgerald
Mr. James J. Devlin
Mr. William F. Burns
Mr. Lawrence C. Langguth
Mr. James K. Connolly
Fr. A. B. Langguth
Fr. J. C. Moynihan
Fr. A. F. McGuinn
Fr. A. D. Ecker
Fr. G. M. Landrey
Fr. Francis W. Power
Fr. Richard B. Schmitt
Fr. Joseph P. Kelly
Fr. Joseph T. Brown
Fr. Joseph J. Sullivan
Fr. Arthur J. Hohman
Mr. J. J. Pallace
Mr. A. A. Hufnagel
Mr. J. H. Thiry
Mr. Joseph A. Martus
Mr. Leo J. Guay
Fr. Thomas B. Butler
Fr. Charles A. Berger
Fr. Harold L. Freatman
Fr. Clarence Shaffrey
Fr. James L. Harley
Fr. Paul L. Carroll
Fr. Joseph Assmuth
Fr. E. A. Callahan
Fr. Arthur Coniff
Fr. Joseph F. Busam
Mr. Joseph W. Murray
Mr. J. J. O'Brien
Mr. Gerald Hennessey
Mr. Francis C. Garvin
Mr. Francis X. Wilkie
Fr. John P. Smith
Fr. William Cusick
Fr. Thomas Barry
Mr. Robert Phelan
Mr. Anthony Eiardi
Mr. William Schweder

MEETING OF EXECUTIVE MEETING

The meeting of the Executive Committee convened at 1:45 P. M. in the Chemistry Lecture Hall.

Fr. Richard B. Schmitt was reappointed Editor-in-Chief of the Bulletin, and Fr. Francis W. Power was appointed Acting Treasurer to collect the assessments for the Bulletin. The latter appointment was made by the Committee in virtue of the power conferred upon it by the Association in the final general meeting. The appointment is temporary, for the present year only.

NEW MEMBERS

Cotter, Rev. Anthony C., Weston College
Coyne, Rev. Francis J., Boston College
Dooley, Rev. Edward, Canisius College
Eiardi, Anthony J., Boston College
Glose, Rev. Joseph C., Woodstock College
Murphy, Rev. John J., Holy Cross College
Fitzgerald, John F., Holy Cross College
O'Beirne, Rev. Stephen L. J., Woodstock College
Ring, James W., Boston College
Schoberg, Rev. Ferdinand, Georgetown University
Thiry, James H., Gonzaga High School

BIOLOGY

CHEMO-MEDICAL RESEARCH LABORATORIES, GEORGETOWN UNIVERSITY

Washington, D. C.

(Report for the yearly period, July 1, 1935, to June 30, 1936.)

M. X. Sullivan

As in previous years, three main lines of research have been carried on: (A) Sulfur metabolism in health and disease; (B) The study of the urine in various pathological conditions; (C) The development of more specific tests for amino acids, amines, and other biologically important constituents of the body fluids and excretions.

Project (A). Studies in arthritis:—On request of various members of the Medical profession and of people in general throughout the country many analyses of finger nail clippings were made of marked cases of arthritis. In confirmation of work of previous years reports from practioners, veterans' hospitals, etc., a high percentage of those patients which show low cystine nails are benefited by injection of colloidal sulphur. The change for the better shows in the finger nails which slowly return to a normal level. Some report benefit even when the nail clippings are normal. As far as can be judged at present the sulfur acts by offsetting injurious agencies or by stimulating the general metabolic activities of the body. Low cystine finding in arthritis have been verified in whole or in part by a number of workers in these fields both in this country and abroad.

Low cystine of finger nails not due primarily to cachexia, malnutrition or chronicity:—To answer the criticism that the lowered cystine content of the finger nails was due to general weakness and chronic state of the long continued arthritic cases we analyzed finger nail clippings of thirty cases of chronic tuberculosis. The finger nail clippings of these far advanced tubercular cases were normal, a finding which verifies our conclusion that there is a specific sulphur and cystine disturbance in arthritis probably due to injurious metabolites which the body tries to offset by combining with sulphur complexes. A number of other pathological conditions tied with perverted metabolism and general intoxication have low cystine nails, due not necessarily to the chronic state but to the type of intoxication.

Rheumatic fever:—At the request of Dr. A. M. Stimson, Medical Director of the U. S. Public Health Service, a study was made of the

finger nail clippings of 12 cases of rheumatic fever. These cases were considered acute cases with heart involvement. These cases all ran low in cystine, in fact the lowest cases we have had contact with. Our conclusion was that the so-called acute cases of rheumatic fever were really the result of a long continued attack with the more or less breaking down of the sulphur defense with acute manifestation.

Cystine studies on wool and skin:—In a cooperative study with the U. S. Department of Agriculture with lambs on adequate and inadequate rations, Sullivan, Hess, Hardy, and Howe (J. Biol. Chem. 109, XC, 1935) found that the cystine contents of the body third of the wool fibre of lambs on adequate ration was at least 10% higher than for the inadequate diet. Later Sullivan and Hess analyzed portions of the hides which had been preserved with salt. After removing the salt and defatting, the hides were analyzed for cystine and total sulphur. The ratio found for the whole defatted hides for inadequate and adequate rations by the three methods employed are: Sullivan 100:144; Okuda 100:145, and total S, 100:139. This experiment seems to show decisively that diet affects the quality as well as the quantity of wool and also the condition of the skin.

Cystine and tryptophane in blood serum:—A modification of the May and Rose test for tryptophane was devised so that tryptophane could be estimated within 30 minutes instead of 4-7 days. Using this modified tryptophane method and the regular cystine method, tryptophane and cystine were determined in normal and pathological sera. The tryptophane was determined on unhydrolyzed sera, the cystine after hydrolysis. Normal serum gave a cystine-tryptophane ratio of 2 to 1, chronic conditions 2 to 1, while acute infective conditions showed an increase in tryptophane, a decrease in cystine so that in many cases the ratio ran 1 to 1.

A short method of estimating cystine in finger nails and blood:—Using a small amount of concentrated sulphuric acid and a higher temperature during hydrolysis, the method for estimating cystine in finger nails has been shortened so that one hour hydrolyzing and one hour colorimetric estimation suffice. This short method can be applied to blood but to-date most of the work has been with finger nail clippings. Forty mgs. of clippings finely cut and 0.15 cc of H_2SO_4 D. 1.415 (made by mixing 2 volumes of concentrated acid with 3 volumes of water) were heated in a small acetylation flask in an oil bath at 150-155°C for 1 hour. The hydrolysate was made to 25 cc. with water. If cloudy the solution was filtered. Cystine was determined by the Sullivan method as used for casein with the exception that 5% NaCN in N NaOH was used in place of aqueous cyanide. The results agree with the 7-hr. HC1 hydrolysis.

Cystine in urine:—A very satisfactory procedure was developed for the determination of cystine in urine. This was applied to normal urine and a report covering the work has been accepted for publication in the Journal of Biological Chemistry.

Muscular dystrophies:—Work with muscular dystrophies was continued and a paper covering the work was published. The conclusion was drawn that muscular dystrophy is due to intoxication with simple guanidine derivatives and that glycerine extract of the suprarenal cortex more or less offset the metabolic fault. The procedure for estimating guanidine in the urine has been greatly improved.

A study was made of the toxicity of guanidine, methyl guanidine, dimethylguanidines and higher complexes. Free guanidine is very toxic to plant and animals. Methylguanidines are less toxic to plant as shown in work done here by Dr. Muldoon and more toxic to animals as shown by German workers. Lime salts offset the toxic action of the guanidines.

With the belief that methylated guanidines might play a part in certain types of heart failure and in high blood pressure a test of a high degree of specificity has been devised for asymmetrical dimethyl guanidine but as yet no evidence has been obtained for its presence in the urine in myasthenia gravis, heart failure, or hypertension.

Vitamin C:—As mentioned a year ago, in developing tests for glutathione, a cysteine complex occurring in the human body, we found it necessary to consider ascorbic acid or vitamin C. For vitamin C we devised a colorimetric test. This test depends on the fact that ascorbic acid will give a blue color with the Folin-Marenzi uric acid reagent. If the reaction is carried out with phosphate buffer 8 in the presence of sodium cyanide and especially in the presence of formaldehyde, ascorbic acid gives a blue color while glutathione, uric acid, cysteine and reasonable amounts of hydroquinone are negative.

The urine contains interfering material which can be removed by treatment with lead acetate. A paper covering our work in comparison with other methods will be given at the vitamin symposium in Pittsburgh, September 8, and will be ready for publication in the near future. The procedure we advocate is less interfered with than any other procedure so far published.

The different phases of the work presented in this report have been or will be detailed in publication.

THE MAINTENANCE OF EQUILIBRIUM

(Abstract)

Rev. Clarence E. Shaffrey, S.J.

Nervous System Conducting System: Receptor—afferent path—centers—efferent path—effector.

Nervous Impulses: Afferent: Exteroceptive—Interoceptive—Proprioceptive .

Proprioceptive Impulses: Functions: Maintenance of equilibrium.
Maintenance of muscular tone.
Report spatial relations.

Proprioceptive Receptors or End-Organs concerned in equilibrium.

1. End-organs of muscular sensibility: nerve endings on muscle spindles of striated muscles which receive their innervation from a cerebro-spinal nerve.
2. End-organs of tendon sensibility.
3. End-organs of joint sensibility.
4. Organs of static and equilibratory sense: semicircular canals.

Paths of Proprioceptive Impulses.

1. To the Cerebral Cortex.
   End-organs in muscles, joints and tendons—spinal ganglion—dorsal root—medial division—posterior funiculus—ascending branch—nucleus gracilis and cuneatus—internal arcuate fibres—decussate—medial lemniscus—ventral portion of lateral nucleus of thalamus—thalamic radiation—posterior Limb of internal capsule—post central gyrus.
2. To the Cerebellum.
   a) By way of the dorsal arcuate fibres.
      Path to nucleus gracilis and cuneatus the same—posterior arcuate fibres—restiform body of same side—through white center of cerebellum to cerebellar cortex.
   b) By way of Ventral Spino-cerebellar Tract.
      Primary neurons the same—posterior gray column and intermediate gray matter—ventral spino-cerebellar tract of same or opposite side—medulla—pons—brachium conjunctivum—anterior medullary velum—cortex of rostral portion of the vermis of cerebellum.
   c) By way of Dorsal Spino-cerebellar Tract.
      Primary neuron the same—nucleus dorsalis in posterior gray column—dorsal spino-cerebellar tract of same side—restiform body—cortex of rostral and caudal portions of the vermis.
3. Vestibular Path.
   Impulse originates in semicircular canals, utricle and saccule—thence—to cells of vestibular ganglion—to vestibular nerve—to vestibular nuclei—
   a) principal nucleus, which is also called the medial or dorsal nucleus—then by medial longitudinal fasciculus to:—
      1. nuclei of the 3rd, 4th, and 6th cranial nerves.
      2. terminate in the superior colliculus.
   b) lateral vestibular nucleus of Deiters—vestibulo-spinal tract—to anterior gray column of cord, and also into the medial longitudinal fasciculus and to 1 and 2 under a) above.
   c) superior vestibular nucleus—to medial longitudinal fascicluus and to 1 and 2 under a).

d) spinal vestibular nucleus—to anterior gray columns of the cord, to nucleus of spinal accessory nerve (11th) cranial nerve.
e) cerebellum directly as well as from the several nuclei indirectly.

4. Visual Path.
Impulse originates in rods and cones of retina—ganglion cells of retina—through optic nerve—optic chiasma—optic tracts—then to three different areas:—
   1. to superior colliculus from which it goes to:—
      a) tecto-spinal tract to ventral gray columns and thence to muscles of body.
      b) to mid-brain and pons, i.e. to nuclei of 3rd, 4th, and 6th cranial nerves which innervate the external muscles of the eye.
   2. to lateral geniculate body—to optic radiation—(see below).
   3. to pulvinar of thalamus, i.e., to lateral nucleus—to optic radiation—to cuneus of occipital lobe. The cuneus is situated between the parieto-occipital and the calcarine fissures.

5. Auditory Path.
Impulse originates in nerve terminals about the hair cells of organ of Corti—to spiral ganglion of cochlea—cochlear nerve—thence to two nuclei:—
   1. dorsal cochlear nucleus—striae medullares on floor of 4th ventricle—decussation—to lateral lemniscus—(see below).
   2. ventral cochlear nucleus—trapezoid body—decussate—to the lateral lemniscus—thence to:—
      a) inferior colliculus—tecto-spinal tract—ventral gray matter of cord—to musculature of body.
      b) medial geniculate body—acoustic radiation—to anterior transverse gyrus of the temporal lobe, superior surface. (Heschl's Convocation).

6. Efferent Impulses from the Cerebellum.
Cerebello-Rubro-Spinal Path.
From Pukinje cells of cerebellar cortex—dentate nucleus—brachium conjunctivum—decussation in tegmentum—inferior colliculus—red nucleus and thalamus. From red nucleus—rubrospinal tract—decussation in ventral tegmentum—anterior gray column of cord.

7. Cortico-ponto-cerebellar Path.
Pyramidal cells of precentral gyrus—ant. limb of int. capsule longitudinal fasciculus pontis—nuclei pontis—brachim pontis—cerebellar cortex—then Purkinje cells of cerebellar cortex—dentate nucleus—etc., as above.

PREPARATION AND USE OF NEICA BIOLOGICAL SPECIMENS

(Abstract)

REV. PAUL L. CARROLL, S.J.

A new medium in which to mount cleared biological specimens is gradually being perfected and is now available for the smaller animals in the invertebrate and vertebrate kingdoms. The exact formula for the medium is not as yet certain, but we can state that celluloid gives it a firmness which holds the animal in position, while oil of wintergreen prevents undue cracking and shrinking. We now use the ordinary 100 mm., 75 mm. and 50 mm., Petri dishes for mounting the animal in the semi-solid medium. The process of dehydrating with alcohol and clearing in benzol or oil of wintergreen is well known to all because of the excellent Spalteholtz preparations. However, in the past, the method has been used almost exclusively on vertebrates. We find that the Porifera, the Coelenterata, the Echinodermata and the worms may be similarly treated and mounted in the new preparation. The smaller mollusca and arthropods also lend themselves to like treatment. The sea-horse and frog skeletons make interesting laboratory demonstration specimens. We have prepared speciments of some thirty animals mounted **in toto**, we have also mounted parts of the frog, such as: the injected lung, ovary, foot, etc. It is our aim to complete a seperate set of such cleared and mounted specimens representing as many animals in each Phyla that will readily lend themselves to such treatment.

EFFECTS OF TEMPERATURE ON VESTIGIAL WINGS OF DROSOPHILA MELANOGASTER

(Abstract)

REV. JAMES L. HARLEY, S.J.

Roberts (1918) first reported the increase in size of the wings of the vestigial mutant of D. melanogaster when reared at high temperatures. Stanley (1928) stated that "the length of vestigial wing varies directly with the temperature, but not in direct proportion." Harnley (1931, 1936) has reported the exact periods during the larval period when the change in size of wing is effected at the temperatures of 30°, 31°, 32° and 33°C.

These findings provide us with a ready experiment or demonstration to show the influence of environment upon an organism.

Good specimens of increased wing size may be obtained from vestigial wing cultures which have been allowed to stand in the incubator (32°C.) during the third, fourth and fifth day of larval life.

CHEMISTRY

MICRO-VAPORIMETRIC DETERMINATION OF MOLECULAR WEIGHTS WITH MACRO ANALYTICAL BALANCE

(Abstract)

Rev. Richard B. Schmitt, S.J.

The classical macro vapor density method of A. W. Hofmann and V. Meyer for the determination of molecular weights was improved by the micro-vaporimetric method of J. B. Niederl, New York University. In this method a few milligrams of a substance, either solid or liquid, are vaporized in a closed system in which mercury is the sealing liquid and is replaced instead of air. This micro method has an accuracy of $\pm$ 2% for solids or liquids with boiling points ranging from 65° to 320°C.

By a series of molecular weight determinations, it is now shown that the same accurate results are obtained with a macro analytical balance using samples that range from 10 to 20 milligrams; thus eliminating the use of a micro balance, and so the Niederl method has greater scope. The advantages of this method are: the simplicity and durability of the apparatus, less danger of breakage, the greater range of substances suitable to this method, and the time of the experiment is shortened. Because of these advantages, this method should replace the Victor Meyer method in the course of Physical Chemistry.

(Motion Pictures and Lantern Slides.)

REACTIONS BETWEEN PRIMARY ARYLAMINES AND ALIPHATIC HALIDES

(Abstract)

Joseph A. Martus, S.J.

A number of references can be found in the literature to reactions between tertiary amines and organic halides, such as piperidine with alkyl bromides, tropine with methyl iodide, dimethylaniline with alkyl iodides, pyridine, B-picoline, A-picoline and quinoline with alkyl bromides, studied mainly from the point of view of reaction rates.

Shriner and Fuson[1] cite the addition compounds formed between methyl iodide and a number of tertiary aryl and aliphatic amines as a means of identifying tertiary amines. However, no references were found to work done with primary arylamines and aliphatic halides. With the hope of finding a suitable derivative for either of these two types, several typical primary amines and aliphatic halides were mixed together; there formed, after varying lengths of time, solid substances which proved on analysis to be addition compounds.

Methods of formation: for the purposes of a systematic investigation, the primary amines were limited to the three toluidines, ortho, meta and para, while the alkyl halides used ranged from the methyl bromide and iodide through the homologous series to normal and isopropyl bromide and iodide. These were mixed in equimolecular quantities, either 0.1M or 0.05M, in order to test the assumption that the compounds formed were 1 to 1 addition compounds. These mixtures were left standing at room temperature, when, after varying lengths of time, the addition compounds sought precipitated out. It so happened in the case of P-toluidine the amount of liquid alkyl halide added was just enough to dissolve the solid.

Several observations were noted in the formation of the compounds. Firstly, there was a considerable evolution of heat. The addition compound formed between methyl iodide and P-toluidine precipitated thus after five minutes from the time of mixing. Precipitation began and ended within ten seconds. None of the other mixtures reacted so swiftly or with so great a spontaneous evolution of heat. The mixture of M-toluidine with the higher normal and isoalkyl halides required two to three days. Furthermore, it was noticed, that in some cases while standing the liquid congealed into a heavy viscous mass; from this the addition compound separated very slowly until the mass was entirely converted into a colored solid. The rates of formation followed in a general way this order:

$$I > Br > Cl$$

$$p > o > m$$

The purification of the addition compounds offered the most difficulty. No general suitable solvent was found, so that it was necessary to use a liquid which would dissolve the impurities and leave the addition compound untouched. Carbon tetrachloride effected this in some cases, while in others ether was used with variable success. A method that was successfully used in a few cases required solution of the compound in chloroform and precipitation with ether. A number of other organic liquids were tested for solubility purposes, but without any encouraging success.

In general these addition compounds resemble each other in a number of their physical and chemical properties. They are all colored, iodides usually yellow, bromides either white, brown, purple or

(1) pp. 124-126, "Identification of Organic Compounds," Shriner and Fuson John Wiley and Sons, New York, (1935).

red. Element analysis showed the presence of nitrogen and halogen. Without exception all the compounds decomposed just above their melting points. In determining the latter, closed M. P. tubes had to be used. They are all soluble in hot or cold water, hot or cold dilute acid and hot or cold dilute alkyl. Cold concentrated sulfuric acid reacts with all the compounds, but the products of this reaction were not investigated. These compounds are also soluble in acetone, chloroform, ethyl alcohol, methyl alcohol, ethyl acetate, but are insoluble in carbon tetrachloride, benzene and ether.

From a consideration of the melting points given in table , it will be seen that the alkyl halides cited, with the exception of isopropyl bromide, are a good means of distinguishing the three toluidines from each other. For example, the compounds formed from ortho, meta and para toluidine and N-propyl bromide have the following widely separated melting points, respectively: 174-175, 75-76, and 258-260. On the other hand P-toluidine could not be used successfully as a reagent for distinguishing the alkyl bromides cited, since the first three melting points lie too close together for identification work. It could be used however, to distinguish N-propyl bromide from isopropyl bromide, since the melting points of the addition compounds are, respectively: 258-260 and 141-142. P-toluidine could be used to distinguish the alkyl iodides cited, as the melting points of the addition compounds are separated by more than 70 degrees. O-toluidine forms addition compounds with the four alkyl bromides, three of which have melting points very close together. It could be used to distinguish the three alkyl iodides cited, including the two propyl iodides. M-toluidine forms addition compounds with the alkyl bromides and the alkyl iodides, that have melting points which are sufficiently separated for identification work. This includes the two propyl bromides and the two propyl iodides.

Summary: 1—Addition compounds have been formed from the reaction of several typical primary arylamines with aliphatic halides.

2—Of the compounds analyzed, the results show that they are 1 to 1 addition compounds with this type formula: $RNH_2 . R'X$.

3—From a consideration of their melting points their use in identifying either aliphatic halides or primary arylamines has been demonstrated.

THE LATENT PHOTOGRAPHIC IMAGE

(Abstract)

LEO J. GUAY, S.J.

According to the theory which is now most commonly accepted, the nature of the latent photographic image consists of minute nuclei of silver which are distributed on the exposed silver halide grains of

the photographic emulsion and which serve as germs for the deposition of the silver liberated in developing. In the formation of the latent image, the radiant energy absorbed by the silver halide activates certain halide ions with the consequent loosening of electrons and the discharging of silver ions to form free silver atoms. In some way, yet uncertain, these silver atoms are aggregated into the silver nuclei which are distributed at random on the original silver halide grains.

OBJECTIVES IN LABORATORY TEACHING

(Abstract)

Rev. Arthur J. Hohman, S.J.

The student in the Arts Course, who seeks only a cultural knowledge of the subject, needs to learn to interpret what he reads. He must be taught not to draw absurd conclusions from results, and not to underrate work that does not have spectacular results. A small amount of laboratory work is necessary, and part of that should be semi-quantitative in nature. He should learn technique because neatness in working is conducive to clearness in thinking, and to become practically aware of the limitations of physical measurements.

The student in the Science Course needs ability to correlate and apply his knowledge. Technique is much more important to him, above all that he know the "why" of each step and operation. His laboratory work must inculcate principles and help him to relate the reactions of one set of compounds to another, and to see the interdependence of all the parts of his subject.

This requires intensive planning, instruction and supervision in the laboratory. The Instructor must circulate through the laboratory, note, check, advise and even help. Proper questioning will bring out the knowledge of the student. In this he must be helped too, given a hint, and left to dig out the answers for himself, even at the cost of some laboratory time.

MATHEMATICS

TEACHER TRAINING IN MATHEMATICS

(Abstract)

Rev. John P. Smith, S.J.

This report was presented to the Trustees of the Mathematical Association of America at the Pittsburgh meeting, December 1935. It consists of two parts: Graduate and undergraduate training. The recommendations concerning preparation for major teaching of secondary mathematics are very specific and should be read by our teachers. The complete report may be found in the May issue of the American Mathematical Monthly.

THE USE OF COMPLEX QUANTITIES IN GEOMETRY

(Abstract)

Charles E. McCauley, S.J.

This paper dealt with the the applications of complex numbers and a few propositions from the theory of equations to determine the constructibility of geometric figures, e.g., the trisection of an angle, construction of a polygon, etc., with ruler and compass. Two general analytic criteria of the possibility of such constructions were established and exemplified. The introduction of complex roots of the equation $y^n - 1 = O$ $(R = \text{cis } \frac{2\Pi k}{n})$ and the use of the transformation $x = R + \frac{1}{R} = 2 \cos \frac{2\Pi}{n}$ were shown to give an easy means of applying the criteria, when the equation defining the desired geometric line element was of high degree.

THE MAKING OF MEASUREMENTS. WHAT IS IT?

(Abstract)

ANTHONY J. EIARDI, S.J.

The purpose of our paper was to set down the philosophy which underlies the process (which we call measure) whereby the dimensions of bodies and their properties are ascertained. The content of the philosophy of measure is found in the definition, the purpose and the usefulness of measure. Suarez defines measure as: 'id quo quantum cognoscimus'. Hence measure is a means of acquiring knowledge; not knowledge of bodies and of their properties, but quantitative knowledge of these things. Consequently, the purpose of measure is to ascertain the howmuchness of things. Knowing what a thing is from its definition, we study its purpose to determine the uses to which it can be put. From the purpose of measure, we readily see that measure plays a very important role in the everyday needs of men and particularly in the needs of a scientist.

ANALYTIC FUNCTIONS IN SOME TWO DIMENSIONAL HYDRODYNAMIC PROBLEMS

(Abstract)

WILLIAM H. SCHWEDER, S.J.

A velocity potential function was set up and its kinematical properties explained. After a brief analysis of fluid motion by the vector method, it was shown how to derive the stream lines and equipotential surfaces from the potential function. The application of the method to several problems was then given.

PHYSICS

POLAROID—THE NEW ARTIFICIAL POLARIZER

(Abstract)

LAURENCE C. LANGGUTH, S.J.

The inadequacy of present polarizing media has been supplied by the development of a new optical plane-polarizing medium, in sheet form, of unlimited cross-sectional area, and of high intensity for the polarized beam. It is known as Polaroid, and consists of crystals of herapathite, a sulfate of iodiquinine, oriented with their optic axes parallel within a cellulose matrix. The crystals are oriented and imbedded in the film in one single process of extrusion. The sheet operates like Tourmaline, to selectively absorb the ordinary ray and transmit only the extraordinary ray, almost completely plane-polarized.

Indicated applications for the new medium are safety automobile lamps and viewplates, three-dimensional motion pictures in full color, control of glare in the photography of shiny objects, and in an altered form as a light valve of variable opacity for the television receiver.

SIDE-BAND LIMITING FILTER

(Abstract)

WILLIAM F. BURNS, S.J.

This problem involves a construction and test of an artificial line (filter) of the low pass type which will be suitable with a transmission of all voice currents corresponding to frequencies below 2,500 cycles. Above the cut-off frequency, for currents corresponding to voice frequency above 2,500 cycles, it is desirable for this work to have a very high attenuation. The work on this problem was prompted by a desire to cut out the outer side-bands of a voice modulated transmitter. The use of this filter would require no alteration on the transmitter itself and even though the transmitter were capable of producing high order side-bands, they would not be generated provided that the filter controlled the audio frequency input from the microphone. A filter of this type would conserve the available frequency spectrum for, let us say, the amateur, and consequently allow more stations to utilize the restricted bands for amateur radio work.

RESEARCH PROGRAMS AT NEW YORK UNIVERSITY

(Abstract)

THEODORE ZEGERS, S.J.

Among the projects mentioned were: Experiments using high speed protons for the disintegration of various elements; experiments with Schuler tubes for studying nuclear spin spectroscopically; and experiments with a type of torsion balance for obtaining a more precise value for the gravitational constant.

THE BENIOFF SEISMOMETER

(Abstract)

DANIEL LINEHAN, S.J.

This paper presented a brief explanation of the new Benioff Seismometer emphasizing especially the advantages of the Benioff transducer over other types in use at present. The method and advantages of operating several galvanometers from a single Seismometer were also explained.

Lantern slides of the instruments, magnification curves, short and long period recordings of the pendulum type seismometers were shown. Others of the Weston instrument arrangement and the recently developed Benioff Linear Strain Seismometer were also included.

AN EXPERIMENTAL INVESTIGATION INTO THE STABILITY OF A NEW RADIO FREQUENCY AMPLIFIER

(Abstract)

JAMES J. DEVLIN, S.J.

This paper briefly considered previous work already done on the problem of building a non-regenerative radio frequency amplifier and the value of this work. A new attack on the problem was presented and the results of some experimental work. Three factors came under consideration: the elimination of regeneration in this type of amplifier, the maintenance of a high amplification factor and the elimination of energy losses in dissipated heat.

NOTES ON APPARATUS

(Abstract)

REV. HENRY M. BROCK, S.J.

This paper was an informal discussion of some recent physical apparatus. The 200-CM General Radio Variac Transformer was described. It is a convenient variable A. C. voltage source. Connected with a power pack it gives any D. C. voltage within its range. The new G-M Power Supply Unit with a dry rectifier gives 7.5 D. C. volts at 6 amperes. It can replace storage batteries for certain purposes and can be used for charging them. In addition, it gives 5, 10 and 15 A. C. volts at 8 amperes. A new mercury lamp has recently been put on the market by the Hanovia Company. It can serve as the light source for three spectrometers at the same time. It is made of glass or quartz the latter being a good source of ultra-violet light. The new G-E Light Meter which is sold at a moderate price is a handy instrument in the laboratory and besides can be used in testing the illumination in living rooms. Several types of the Cathode Ray oscillograph were mentioned. The versatility of this instrument makes it a very desirable addition to one's physical equipment. Prices are much lower now. Reference was also made in passing to the Zeiss Planetarium, undoubtedly the most remarkable mechanism ever designed for the teaching of astronomy. There is one in New York and in Philadelphia. It is well worth visiting when one is in either city and students should be urged to see it.

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Cheney, Edmund K., 1935, Université St. Joseph, Beirut.
Cummings, William V., 1932, Woodstock College.
Doino, Rev. Francis D., 1930, Ateneo de Manila.
Ecker, Rev. Anthony I., 1931, Weston College.
Fiekers, Bernard A., 1933, Ignatius College, Valkenburg, Holland.
Gisel, Rev. Eugene A., 1925, Ateneo de Manila.
Gorman, Rev. Lawrence C., 1926, Loyola College.
Guay, Leo J., 1935, Holy Cross College.
Haggerty, Gerard A., 1934, St. Joseph's High School.
Hauber, Rev. Edward S., 1929, St. Andrew-on-Hudson.
Hohman, Rev. Arthur J., 1922, St. Peter's College.
Hufnagel, Alvin A., 1933, Innsbruck, Tyrol, Austria.
Hutchinson, Gerald F., 1933, Weston College.
Kelleher, William L., 1932, Weston College.
Landrey, Rev. Gerald M., 1930, Weston College.
Langguth, Rev. Aloysius B., 1924, Boston College.
Martus, Joseph A., 1934, Boston College.
McCawley, Edward G., 1934, Brooklyn Preparatory.
McCullough, Rev. Henry B., 1925, Ateneo de Manila.
McGuinn, Rev. Albert F., 1932, Weston College.
Molloy, Rev. Joseph J., 1929, St. Andrä, Lavanttal, Kärnten, Austria.
Moynihan, Rev. Joseph C., 1930, St. Robert's Hall.
Muenzen, Rev. Joseph B., 1923, Fordham University.
O'Byrne, Rev. Francis M., 1934, Woodstock College.
Pallace, James J., 1934, Fordham University.
Power, Rev. Francis W., 1924, Fordham University.
Quevedo, Anthony J., St. Peter's High School.
Schmitt, Rev. Richard B., 1923, Loyola College.
Sullivan, Rev. Joseph J., 1923, Holy Cross College.
Thiry, James H., 1935, Gonzaga High School.

MATHEMATICS SECTION

Officers

Chairman, Rev. Thomas D. Barry, Weston College.

Secretary, Anthony J. Eiardi, Boston College.

Members

Barry, Rev. Thomas D., 1926, Weston College.
Berry, Rev. Edward B., 1922, Georgetown University.
Brock, Rev. Lawrence M., 1930, St. Robert's Hall.
Carey, Philip A., 1934, Woodstock College.
Cohalan, Joseph F., 1934, Georgetown University.
Connolly, James K., 1933, Weston College.
Cusick, Rev. William H., 1928, Holy Cross College.
Dawson, Rev. James F., 1922, St. Joseph's College.
Depperman, Rev. Charles E., 1923, Manila Observatory.
Donohue, Joseph J., 1934, Weston College.
Doucette, Rev. Bernard F., 1925, Manila Observatory.
Duross, Rev. Thomas A., 1932, St. Andrew-on-Hudson.
Dooley, Rev. Joseph C., 1934, Weston College.
Dutram, Rev. Francis B., 1931, Weston College.
Eiardi, Anthony J., 1935, Boston College.
Fey, Rev. Leo F., 1926, Fordham University.
Gallagher, Eugene B., 1934, Canisius College.
George, Severin E., 1933, Woodstock College.
Gipprich, Rev. John L., 1922, Chaptico, Md.
Hennessey, James J., 1933, Ateneo de Manila.
Judah, Rev. Sidney J., 1934, Winchester Park.
Kane, Rev. Matthew W., 1933, Woodstock College.
Kelley, Rev. Joseph M., 1922, Loyola High School.
Love, Rev. Thomas J., 1923, Loyola College.
McCauley, Charles E., 1934, Gonzaga High School.
McCormick, Very Rev. James T., 1923, Boston College.
McDevitt, Edward L., 1933, St. Peter's College.
McNally, Rev. Paul A., 1923, Georgetown University.
Merrick, Rev. Joseph P., 1923, Baghdad, Iraq.
Morgan, Carol H., 1933, Weston College.
Muldoon, Leo R., 1934, Weston College.
Murray, Rev. Joseph L., 1928, Winchester Park.
Nuttall, Rev. Edmund J., 1925, Manila Observatory.
O'Brien, Kevin J., 1933, Fordham University.
O'Callahan, Rev. Joseph T., 1929, Georgetown University.
O'Donnell, Rev. George A., 1923, Boston College.
Phillips, Rev. Edward C., 1922, Woodstock College.
Quigley, Rev. Thomas H., 1925, Loyola High School.
Repetti, Rev. William C., 1922, Manila Observatory.
Rooney, Albert T., 1933, Woodstock College.

Schweder, William H., 1933, Georgetown University.
Smith, Rev. John P., 1923, St. Peter's College.
Smith, Thomas N., 1934, Woodstock College.
Sheehan, Rev. William D., 1928, Baghdad, Iraq.
Sohon, Rev. Frederick W., 1924, Georgetown University.
Sweeney, Rev. Joseph J., 1930, Weston College.
Wessling, Rev. Henry J., 1923, Boston College High School.
Zegers, Theodore A., 1934, Fordham University.

THE PHILOSOPHY OF SCIENCE

Ahern, Rev. Michael J., 1922, Weston College.
Cotter, Rev. Anthony C., 1936, Weston College.
Coyne, Rev. Francis J., 1926, Boston College.
Dooley, Rev. Edward, 1936, Canisius College.
Eiardi, Anthony J., 1935, Boston College.
Glose, Rev. Joseph C., 1930, Woodstock College.
Kelly, Rev. Joseph P., 1931, Weston College.
Lynch, Rev. J. Joseph, 1925, Fordham University.
Murphy, Rev. John J., 1936, Holy Cross College.
O'Beirne, Rev. Stephen L. J., 1936, Woodstock College.
O'Callahan, Rev. Joseph T., 1929, Georgetown University.
O'Conor, Rev. John S., 1928, 14 Cobb St., Boston, Mass.
Ring, James W., 1935, Boston College.
Schoberg, Rev. Ferdinand, 1936, Georgetown University.
Sohon, Rev. Frederick W., 1924, Georgetown University.
Tobin, Rev. John A., 1923, Boston College.
Toohey, Rev. John J., 1934, Georgetown University.

PHYSICS SECTION

Officers

Chairman, Rev. John A. Tobin, Boston College.
Secretary, Laurence C. Langguth, Holy Cross College.

Members

Berry, Rev. Edward B., 1922, Georgetown Preparatory.
Brock, Rev. Henry M., 1922, Weston College.
Brock, Rev. Lawrence M., 1930, St. Robert's Hall.
Burns, William F., 1935, Holy Cross College.
Connolly, James K., 1933, Weston College.
Crawford, Rev. William R., 1924, Boston College High School.
Crotty, Rev. Edward M., 1932, Fordham University.
Daley, Rev. Joseph J., 1930, Manresa Institute, South Norwalk, Conn.
Dawson, Rev. James F., 1923, St. Joseph's College.
Delaney, Rev. Joseph P., 1923, Canisius College.
Depperman, Rev. Charles E., 1923, Manila Observatory.
Devlin, James J., 1934, Boston College.

Doherty, Rev. Joseph G., 1930, Cambridge University, England.
Dowling, William H., 1935, Georgetown University.
Dutram, Rev. Francis B., 1931, Weston College.
Fey, Rev. Leo F., 1926, Fordham University.
Fitzgerald, John F., 1935, Holy Cross College.
Frohnhoefer, Rev. Frederick R., 1926, St. Francis Xavier High School.
George, Severin E., 1933, Woodstock College.
Gipprich, Rev. John L., 1922, Chaptico, Md.
Guicheteau, Armand J., 1932, Woodstock College.
Hearn, Rev. Joseph R., 1925, Woodstock College.
Hennessey, James J., 1933, Ateneo de Manila.
Heyden, Francis J., 1931, Woodstock College.
Kolkmeyer, Rev. Emeran J., 1922, Georgetown University.
Langguth, Laurence C., 1935, Holy Cross College.
Linehan, Rev. Daniel, 1931, Weston College.
Love, Rev. Thomas J., 1923, Loyola College.
Lynch, Rev. J. Joseph, 1925, Fordham University.
McDevitt, Edward L., 1933, Woodstock College.
McGrath, Philip H., 1932, Woodstock College.
McKone, Rev. Peter J., 1931, Weston College.
McNally, Rev. Herbert P., 1922, Canisius High School.
Merrick, Rev. Joseph P., 1923, Baghdad, Iraq.
Miller, Walter J., 1931, Woodstock College.
Moore, Rev. Thomas H., 1923, Fordham University.
Morgan, Carol H., 1933, Weston College.
Murray, Rev. Joseph L., 1928, Winchester Park.
Nuttall, Rev. Edmund J., 1925, Manila Observatory.
O'Brien, Kevin J., 1933, Fordham University.
O'Callahan, Rev. Joseph T., 1929, Georgetown University.
O'Conor, Rev. John S., 1928, 14 Cobb St., Boston.
Phalen, Robert P., 1935, Boston College High School.
Phillips, Rev. Edward C., 1922, Woodstock College.
Quigley, Rev. Thomas H., 1925, Loyola High School.
Rafferty, Rev. Patrick, 1923, Loyola High School.
Reardon, Timothy P., 1935, Woodstock College.
Reed, Francis W., 1932, Woodstock College.
Ring, James W., 1935, Boston College.
Schweder, William H., 1933, Georgetown University.
Sheehan, Rev. William D., 1928, Baghdad, Iraq.
Smith, Rev. John P., 1923, St. Peter's College.
Smith, Rev. Thomas J., 1925, Georgetown University.
Thoman, A. Robert, 1933, Canisius High School.
Tobin, Rev. John A., 1923, Boston College.
Tynan, Rev. John G., 1926, Fordham University.
Walsh, Lincoln J., 1931, Woodstock College.
Welch, Rev. Leo W., 1932, St. Andrew-on-Hudson.

N.B. If there are any errors or omissions in this list, please notify the Editor.